

WHAT IS CLAIMED IS:

1 1. An apparatus for forming a material on a semiconductor wafer, the
2 apparatus comprising:
3 a processing chamber defined by walls;
4 a wafer support positioned within the processing chamber and configured to
5 receive a semiconductor wafer;
6 a processing gas supply; and
7 a gas distribution showerhead overlying and separated from the wafer support,
8 the gas distribution showerhead comprising a face plate having an inlet portion comprising a
9 hole in fluid communication with an elongated slot of an outlet portion of the face plate.

1 2. The apparatus of claim 1 wherein a length of the elongated slot is at
2 least one-half a thickness of the face plate.

1 3. The apparatus of claim 1 wherein the gas distribution showerhead
2 further comprises a blocker plate including a perforation, the blocker plate positioned
3 upstream of, and in fluid communication with, the inlet portion of the face plate.

1 4. The apparatus of claim 1 wherein the elongated slots are continuous
2 and oriented concentrically.

1 5. The apparatus of claim 1 wherein a cross-sectional width of the
2 elongated slot is larger than a cross-sectional width of the hole.

1 6. The apparatus of claim 5 wherein the cross-sectional width of the
2 elongated slot is at least 2.25x larger than the cross-sectional width of the hole.

1 7. A gas distribution face plate comprising:
2 a face plate body having a thickness;
3 an inlet portion configured to receive a flow of a processing gas, the inlet
4 portion comprising an aperture having a width;
5 an outlet portion configured to convey the processing gas flow to a
6 semiconductor wafer, the outlet portion comprising an elongated slot in fluid communication
7 with the aperture.

1 8. The gas distribution face plate of claim 7, wherein the elongated slot
2 has a length at least one-half the thickness of the face plate body.

1 9. The gas distribution face plate of claim 7 wherein the elongated slot is
2 circular and continuous.

1 10. The gas distribution face plate of claim 7 wherein a width of the
2 elongated slot is greater than the width of the aperture.

1 11. The gas distribution face plate of claim 10 wherein the width of the
2 elongated slot is at least 2.25x larger than the width of the aperture.

1 12. An apparatus for forming a material on a semiconductor wafer, the
2 apparatus comprising:
3 a processing chamber defined by walls;
4 a wafer support positioned within the processing chamber and configured to
5 receive a semiconductor wafer;
6 a processing gas supply; and
7 a gas distribution showerhead overlying the wafer support and including a
8 tapered face plate proximate to the wafer support, an edge of the tapered face plate exhibiting
9 a reduced thickness relative to a thickness of a center of the face plate to create a taper angle,
10 such that material deposited on a wafer in contact with the wafer support exhibits a uniform
11 center-to-edge thickness.

1 13. The apparatus of claim 12 wherein the taper angle is between about
2 0.5° and 5°.

1 14. The apparatus of claim 12 wherein the tapered face plate comprises:
2 an inlet portion configured to receive a flow of a processing gas, the inlet
3 portion comprising an aperture having a width;
4 an outlet portion configured to convey the processing gas flow to a
5 semiconductor wafer, the outlet portion comprising an elongated slot in fluid communication
6 with the aperture.

1 15. The apparatus of claim 14, wherein the elongated slot has a length at
2 least one-half a thickness of the face plate.

1 16. The apparatus of claim 14 wherein the elongated slot is circular and
2 continuous.

1 17. The apparatus of claim 14 wherein a width of the elongated slot is
2 greater than the width of the aperture.

1 18. The apparatus of claim 17 wherein the width of the elongated slot is at
2 least 2.25x larger than the width of the aperture.

1 19. A method of distributing gas during a semiconductor fabrication
2 process comprising:
3 flowing a gas from a gas source to an inlet portion of a gas distribution face
4 plate featuring a hole having a width; and
5 flowing the gas from the hole to a surface of a semiconductor wafer through
6 an elongated slot of an outlet portion of a gas distribution face plate.

1 20. The method of claim 19 wherein the gas is flowed through an
2 elongated slot having a length at least one-half a thickness of the gas distribution face plate.

1 21. The method of claim 19 wherein at least one of a carrier gas and a
2 process gas are flowed through the face plate.

1 22. The method of claim 19 wherein the gas is flowed during a chemical
2 vapor deposition (CVD) process.

1 23. The method of claim 19 wherein the gas is flowed during a process of
2 high temperature deposition of undoped silicate glass, such that a spacing between the face
3 plate and the wafer is 300 mils or less.

1 24. The method of claim 19 wherein the flowed gas is selected from at
2 least one of the group consisting of tetraethylorthosilane (TEOS), triethylphosphate (TEPO),
3 triethylborate (TEB), ozone (O₃), oxygen, helium, and nitrogen (N₂).

1 25. The method of claim 19 wherein the flowed gas results in deposition of
2 a material selected from the group consisting of borosilicate glass (BSG), phosphosilicate
3 glass (PSG), and borophosphosilicate glass (BPSG).

1 26. The method of claim 19 wherein the gas is flowed from the gas
2 distribution faceplate having an edge portion recessed relative to a center portion to create a
3 face plate taper angle of between about 0.5° and 5°.

1 27. The method of claim 19 wherein the gas is flowed during a dry etching
2 process.

1 28. An apparatus for forming a material on a semiconductor wafer, the
2 apparatus comprising:
3 a processing chamber defined by walls;
4 a wafer support positioned within the processing chamber and configured to
5 receive a semiconductor wafer;
6 a processing gas supply; and
7 a gas distribution showerhead overlying the wafer support and including a
8 tapered face plate proximate to the wafer support, the tapered face plate comprising,
9 an inlet portion configured to receive a flow of a processing
10 gas, the inlet portion comprising an aperture having a width, and
11 an outlet portion configured to convey the processing gas flow
12 to a semiconductor wafer, the outlet portion comprising an elongated slot in
13 fluid communication with the aperture,
14 wherein an edge of the tapered face plate exhibits a reduced thickness relative
15 to a thickness of a center of the face plate to create a taper angle, such that material deposited
16 on a wafer in contact with the wafer support exhibits a uniform center-to-edge thickness.

1 29. The apparatus of claim 28 wherein the taper angle is between about
2 0.5° and 5°.